REMARKS

Claims 1, 3-9, 11, 14-35, and 45-48 are presently pending for the Examiner's review and consideration. Claims 1, 27, 30, 32, and 35 have been amended to more particularly define the invention under 35 U.S.C. § 112, second paragraph. Claim 32 has been amended to correct a typographical error and is supported, for instance, by Figs. 5a-5g and the related text. New claims 45-48 have been added and are fully supported by the originally filed specification, claims, and drawings. Claims 2, 10, 12, and 13 have been canceled without prejudice since recitations based on these claims have been added to claim 1. Claim 35 has also been amended to recite a handling substrate, which is supported, for instance, in original claim 2, 10, 12, and 13. Claims 36-44 were withdrawn from consideration and have thus been canceled without prejudice.

In the Office Action, claims 30 and 31 were rejected under 35 U.S.C. § 112, second paragraph based on the definition of "providing a repeating pattern of first and second layers." An exemplary embodiment of the repeating pattern of claim 30 is shown in Fig. 5b. As would be clear to one of ordinary skill in the art, the pattern includes a first layer 3 and second layer 6, which pattern is repeated by the provision of a first layer 21 and a second layer 22, which have substantially the same characteristics as layers 3 and 6, respectively. Each first layer in this embodiment is a strained layer, and each second layer is a strain-retaining layer. The pairs of these layers are repeated in the pattern shown. One of ordinary skill in the art would understand that the a repeating pattern of layers includes at least two layers, namely the first and second layers recited, which are arranged in a repeating pattern, such as in the embodiment discussed.

The rejection includes several questions, including what the pattern is, what it does, what repeats, how it should be repeated on the first and second layers, and whether the layers are single or multiple. To the extent these questions are relevant to the definiteness of claim 30, one of ordinary skill would understand the answer from the disclosure. Specifically, as explained above, the pattern includes at least two layers since it is defined as including first and second layers in claim 30. With regard to what the pattern does, claim 30 defines that multiple transfers of portions of the pattern to receiving substrates are performed to produce product wafers. The arrangement of the layers can be found repeated throughout the pattern, such as the repeating pattern of strained and strain-retaining layers in the embodiment of Fig. 5b. With regard to whether the layers are single or multiple, this is not considered relevant to the definiteness of the claim. For instance, it is foreseen that a section of the pattern with many single layers can alternatively be described as a pattern with two

layers, in which one of the layers has several sublayers. Although the embodiment of Fig. 5b has repeated groups, with each group having two layers, the scope of the claim goes beyond the preferred embodiment.

Additionally, new claims 45-47 further define the repeating pattern. All of the claims are believed to be definite under section 112, second paragraph.

Claims 30-31 were rejected as anticipated under 35 U.S.C. § 102(e) over Cheng. The rejection alleges that Cheng discloses performing multiple transfers of portions of the layers to receiving substrates to produce product wafers.

Claim 30 is directed to a method of producing a semiconductor wafer in which a repeating pattern of first and second layers is provided and multiple transfers are performed, transferring portions of the pattern to receiving substrates to produce product wafers. Each transferred portion includes at least one of the first layers.

On the other hand, Cheng merely discloses a silicon substrate, a graded buffer, and a relaxed layer, as described in Fig. 1B, Figs. 5-7, and the related description. There is no teaching or suggestion of any repeated pattern. The description of Fig. 8 teaches a donor silicon substrate, a graded buffer layer 804, a relaxed layer 806, and a strained layer 808. In this embodiment too, there is no repeated pattern of any layers. It is noted that the dashed lines in layers 506, 606, 706, and 806 in Figs. 6-8 do not represent successive layers, but instead represent that the overall layer is graded in composition. (*E.g.*, Cheng 5:30-36.)

Moreover, Cheng does not provide any teaching or suggestion for forming multiple transfers of portions of a pattern. Cheng discloses, for instance, that a donor wafer can be used again as a donor wafer after a Smart-Cut® process is conducted to transfer a film. (Cheng 4:45-50.) While it is well known to repeat Smart-Cut® type transfers of portions of a donor wafer, this in no way suggests providing a repeating pattern so that multiple portions of the pattern can be transferred as it would not be transferring any part of a pattern that repeats, but instead would be transferring chunks of a single layer of Cheng with no distinguishable sublayers.

The invention of claim 30 provides the surprising benefit over Cheng and the prior art that steps that are typically conducted to provide different layers to be transferred, such as surface preparations and material deposition, can be conducted and repeated various times before the transfer of each layer. Then, the transfer of the various layers can take place subsequently. This can lead to substantial savings in manufacturing, since a single donor wafer can be much more quickly or even immediately ready for multiple layer transfers, and

the wafer would not need to be placed back and forth into one piece of equipment that prepares and grows a layer, and then into a piece of equipment that performs the transfer.

The Office Action also includes the general statement Kub disclosed the invention of claim 30. Upon review of the Kub disclosure, however, at least a repeating pattern of layers to be transferred is also not taught or suggested. Based on the above, claims 30 and 31 are neither taught nor suggested by the references of record.

Claims 32-34 were rejected under 35 U.S.C. § 103(a) as obvious over Cheng. Claim 32 defines successively growing a first strained layer in a strained state on a matching substrate, providing a first strain-retaining layer with the first lattice parameter on the first strained layer to maintain the strain, growing a second strained layer on the first strain-retaining layer to impart the lattice parameter in the second strained layer, and then successively transferring at least the second strained layer to a second receiving substrate, and then transferring at least the first strained layer to a first receiving substrate. Thus, at least two product wafers are produced, each with one of the strained layers. There is no disclosure in the prior art or suggestion to provide two strained layers in a single wafer, which strained layers are successively transferred to different receiving substrates. As explained above, any repetition of a layer transfer step known in the prior art is conducted after the donor substrate is first reclaimed, and is not conducted from successive portions of a repeating pattern that includes two types of layers.

The Examiner states that, "the splitting of one step into two," where the processes are substantially identical or equivalent in intention or function, manner, and result is generally not grounds for patentability. The difference between claim 32 and Cheng, is not merely the splitting of one step into two. The process is substantially different from Cheng since the claimed method allows the order of the steps of layer preparation and transfer to be changed. The function, manner, and result are also substantially different from Cheng, since, for example, similar processes can be conducted together instead of varying back and forth between two different types of processes. As explained above, the process of preparing a wafer with the repeating pattern can be conducted in advance of the layer transfers, and the layer transfer processes can be provided without multiple intermediate processes of epitaxial reformation of a donor wafer. Additionally, strained layers are typically very fragile, and the strain-retaining layers preserve the strain in the strained layers between the multiple transfers. These strained layers can experience multiple treatments, such as heat treatments, which could normally cause damage to a strained layer or loss of its strain, but the provision of the strain-retaining layers in the repeating pattern provides the surprising benefit of preserving

the quality of the strained layers between transfers. Since Cheng does not disclose multiple strained layers that are subsequently transferred to different substrates, it does not provide any motivation or suggestion to one of ordinary skill in the art to provide repeated strain-retaining layers adjacent various strained layers to be transferred. Claim 34 further defines providing a second strain-retaining layer on the second strained layer. Consequently, claims 32-34 are also patentably distinct from the references of record.

Claims 1 and 35 was rejected under 35 U.S.C. § 102(e) as anticipated by Kub, and claims 2-29 were rejected under 35 U.S.C. § 103(a) as obvious over Kub in view of Cheng. Claims 1 and 35 has recite that the matching layer is provided on a handling substrate that has a second lattice parameter, different than the first lattice parameter on the first surface of the matching layer.

First, neither Cheng nor Kub provides any reason to a person of ordinary skill in the art to transfer a layer of material in a strained state from one wafer to another. The only motivation to transfer a strained layer of material is found using impermissible hindsight when viewing disclosure of the present application. Although the Office Action states that Kub discloses growing a strained layer, associating it with a receiving substrate, and splitting the composite structure at a region of weakness to form a product wafer that includes the strained layer, this is not the case. While Kub does provide a strained layer, this reference is aimed at making silicon-on-insulator compliant substrate.

Claim 1 defines that a region of weakness is created in a matching layer, and that a first strained layer that is grown on the matching layer is transferred to a receiving substrate by splitting at the region of weakness. The hydrogen ion implantation layer in Kub, however, is taught as being implanted in the underlying silicon substrate. There is no motivation to provide the graded layer of Cheng instead of the silicon substrate of Kub, since the purpose of a graded layer is to bridge from the lattice parameter of one material to the lattice parameter of another material. Moveover, the SiGe layer of Kub is not the equivalent of the graded layer of Cheng, and cannot be considered as such. There is no suggestion or motivation to replace this etch stop layer with any matching layer, since the etch stop layer is merely provided to be etched away after the splitting step. In fact, the etch stop layer is disclosed as being only 30 nm thick (Kub 5:15-27), while the damaged zone formed by hydrogen ion implantation is typically on the order of 100 nm in thickness (example, Cheng 4:47). This much larger thickness of the damaged zone produced by the implantation evinces that one of ordinary skill in the art would actually have been taught away from implanting in the etch stop layer since, otherwise, the silicon layer below the etch stop layer would not be

protected and would also likely be damaged, thus substantially harming any silicon-on-insulator wafer produced.

Additionally, Kub is silent about any strained state of the silicon layer that is provided over the etch stop layer. Kub teaches the fabrication of silicon-insulator substrates for compliance effect (see Kub 2:40-49 and 3:10-20.) In these type of manufactures, it is expected that any strain imparted to the top thin layer will be dissipated by the layer itself, in the buried oxide layer in the silicon-on-insulator wafer, or in an interface in the wafer. The Kub teaching thus teaches to people of ordinary skill in the art that any strain of the silicon layer that is transferred would be lost once the layer that imparted the strain is removed, such as when the etch-stop layer is etched away. To the contrary, claim 35 defines that the strained layer remains in the strained state after the transfer, and claim 45 provides a similar recitation dependent from claim 1.

Also, neither Cheng nor Kub provide any reason for transferring a layer of strained material, and any such motivation is only found in light of the disclosure of the present application using impermissible hindsight. As disclosed and as specifically claimed, for example, in claims 15-19, maintaining the strain in the strained layer after transfer can be used to modify the energy band structure of the semiconductor material to improve the electrical properties thereof compared to the same material in a relaxed state.

Finally, claims 1 and 35 also define smoothing roughness from a portion of the matching layer that is retained on the strained layer after the splitting, and etching the smoothed portion from the first strained wafer. This is not taught or suggested in the references of record. These steps provide the surprising advantage found by the inventors is that when rough layer is etched, the etching at the low areas of the area to be etched can cause damage to the layer therebeneath. By smoothing the layer prior to etching, the thin strained layer can be protected, since its uniformity and quality typically is very significant in the finished product. For this reason as well, these claims are neither taught nor suggested in the art.

Consequently, claims 1 and 35 and all of the claims dependent thereon are neither taught nor suggested by the references of record.

It is believed that the entire application is presently in condition for allowance. Should any issues remain, a personal or telephonic interview is respectfully requested to discuss the same in order to expedite the allowance of the application.

Respectfully submitted,

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